Pollination based optimization to Improve Lifetime of sensor network

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Abstract

The sensor nodes are very small devices with wireless communication capability, which can collect information and processed different sensed information and transfers it to the other nodes. The difficult task in this network is lifetime and energy consumption. The cluster based routing protocols are accepted to improve the network lifetime and to minimize the energy consumption of wireless sensor network. Routing protocol is used to transmit data among sensor nodes in the network .Any security mechanism for sensor network must be energy efficient as security is the major concerned when they will be used in large scale as sensors have limited power and computational capability and should not be computational intensive. Here we study the energy-efficient secure routing protocol for wireless networks based on data aggregation [3]. In this paper, we proposed a new routing protocol based on LEACH protocol. The PBO algorithm is used to improve lifetime of WSN. The node that has minimum distance from the base station and maximum remaining energy will be selected as CH.If the two nodes having the same energy then cluster head will be selected on the basis of distance. The Simulations results show that the OLEACH-C protocol selects the best CHs [1]

Keywords: sensor node, LEACH, PBO algorithm, base station

Introduction:

Wireless sensor network consists of number of small, low power, low cost sensor nodes with limited memory. It also contains computational, and communication resources and a Base Station. Sensor nodes collect data about the physical environment in which they are installed. It transmits the collected data to the BS. BS is a gateway from sensor networks to the outside world. The BS has a very large storage and large data processing capabilities. It passes the data that collects from sensor nodes to the server from where end-user can access them [2].

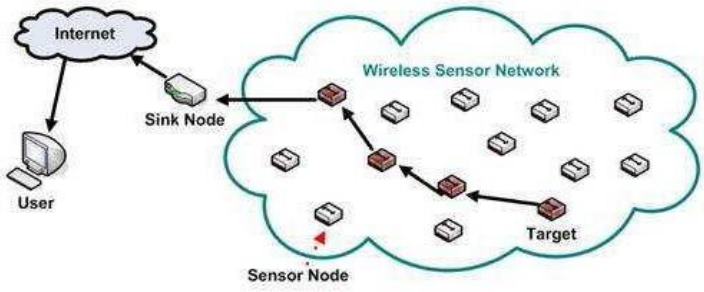

Figure 1: Wireless sensor network [3]

Wireless sensor networks have been applied in military services and civilian services. WSN is classified as ad-hoc network; however the routing protocols used in WSN having many differences to traditional ad-hoc networks in which the most important issue is network energy consumption [1]. the routing

protocols used in WSN *focus on how to* increase the life-time of the entire network rather than looking for the shortest route, reducing time-delay or optimizing bandwidth as in the traditional network protocol such as mobile ad-hoc networks or cellular networks.[3]

The primary hierarchical protocol is the Low Energy Adaptive Clustering Hierarchy (LEACH). The LEACH enhances the energy consumption because the transmission will only be completed by the cluster heads rather than the all the nodes [1]

LEACH Protocol

Low Energy Adaptive Clustering Hierarchy (LEACH)[1] is one of the mostly used hierarchical cluster-based routing protocols for wireless sensor network. LEACH is a data aggregation algorithm based on cluster based routing. In such a situation, the data from the each node have to send to a central base station, often located far from the sensor network, through which the end-user can access the data. LEACH is a self-organizing, adaptive clustering protocol that uses randomization to allocate the energy load equally among the sensors in the network. The LEACH protocol is works in rounds such that each round has two phase's i.e setup and steady state phase [1].

In the setup phase, Cluster Head (CH) selection is based on two factors. First, the percentage P of nodes in network and secondly history of nodes that has served as CH. A threshold value T (n) is set and decision is made by each node n based on the random number i.e. lies between 0 and 1. If the random number is less than threshold value, (T (n)), then, the node become a cluster head for the current round. The threshold value calculated based on the equation given below:

$$T(n) = \begin{cases} \dfrac{P}{1 - P * r \bmod \left(1/P\right)} & n \pounds G \\ 0 \text{ Otherwise} & \end{cases}$$

Here *P* is the desired percentage of cluster heads and *r* is the current round, G is the group of nodes that has not been the CHs in the last rounds. The sensor node i.e. selected as a CH is not selected in the next rounds until all other nodes in the network becomes cluster heads. [1]

After electing CH, the CHs will broadcast messages into the entire network, the nodes base on the**received signal strength indicator** (RSSI) to decide to join their CH, and this is the principle ofthe clusters in LEACH.[3]

In the steady state phase, nodes send their collected data by using their allocated TDMA slot to CH. The CH aggregates the data when received and send it to the Base Station (BS). [1]

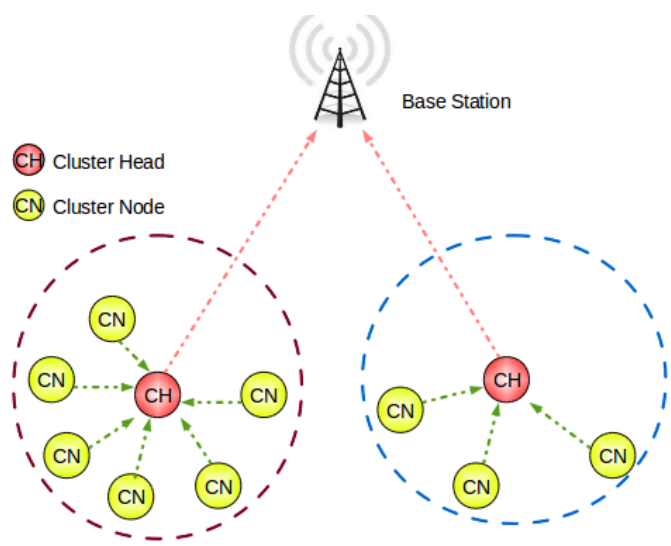

Fig 2 LEACH aggregation algorithm [1]

Random election of CH also has many drawbacks. The biggest drawbacks is the random election making the high-energy nodes have the same probability of becoming cluster as low energy nodes.

The CHs functions have sensing as normal nodes. CHs also receive data from the nodes in the cluster, aggregate the received data and transmit it to the BS, so that CH consumes more energy than normal node. If low-energy nodes become CH, it will consume more energy wich results, the low-energy nodes will stop working quickly. [3]

Moreover, single-hop transition methods used in LEACH make CHs far from BS Consume more energy than CHs close to BS so that CHs far from BS die quickly. [3]

Related work:

LEACH-C

LEACH-C is a modified LEACH using centralized clustering control, which is the same steady-state phase protocol as LEACH. LEACH-C is different from LEACH at Step 1 and Step 2 in the setup phase. In the setup phase of LEACH-C, each node transmits information about its current position (possibly determined using a GPS receiver) and its residual energy level to the BS. The BS will select the number of optimal CHs and configure the network into clusters for the current round. Afterwards, the BS broadcasts an advertisement message to all sensor nodes in the network; this message contains the identification of CHs and identification of member nodes.[4]

MULTI-HOP LEACH

Multi-hop LEACH (LEACH-M).In this protocol, the sensor nodes can communicate with in multi-hop fashion. It's not necessary all the nodes send the data only to base station. The one node sends the data to its neighbor. However, this proposed protocol requires each sensor should be able to aggregate data, which increase the cost and overhead of sensor nodes.[1]

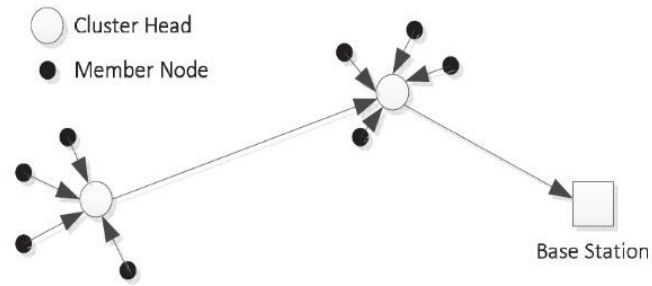

Figure 3. Transmit data in Multi-hop LEACH.[3]

EELEACH-C

To provide better the energy consumption and to enhance the network lifetime of the WSN, new version of LEACH-C has been proposed. This presents the energy efficient LEACH-C (EELEACH-C) protocol. In this, the base station refers a sorting algorithm and creates the list of nodes in descending order based on their remaining energy. The node with maximum residual energy will be selected as a cluster head for the current round. The overall performance of the protocol is good. But there are some disadvantages of the EELEACH-C protocol. Because if the two or more nodes having the same energy in the network then, cluster head will be selected based on the node's id rather than distance . So this technique will not be able to increase the performance of existing LEACH protocol in a very significant manner. It consumes the more energy and greater cost. So in the proposed work our aim is to design a protocol over which the cluster head will be chosen on the basis of optimization technique such as PBO (pollination based optimization), in this, the nodes will be selected as the cluster head based on the energy and distance. If the two nodes that can be selected as cluster head having same energy, then cluster head will be selected on the basis of distance rather than their ID. The node with minimum distance

from the base station will be selected as a CH. The proposed system model will be able to improve the performance of existing LEACH protocol to significant level in terms of energy efficiency, cost and network lifetime. [1]

Proposed work:

This section introduces an improvement to the LEACH protocol, which we call O LEACH-C i.e Pollination Based Optimization. It reduces the energy consumption of micro-sensor nodes to extend WSN lifetime. First, we simplify a few reasonable assumptions in the network model as follows

- All micro-sensor nodes deployed within a square area are homogeneous.
- All micro-sensors and the BS are stationary after deployment.
- All micro-sensor nodes use only the initial battery power and are not recharged.
- All micro-sensor nodes are location-aware (e.g., sensor nodes are equipped with GPS receivers or location detectiondevices).

Pollination based optimization (PBO) algorithm is used to improve the lifetime of the network and to minimize the energy consumption of the nodes. The pollination base optimization is a latest population based optimization algorithm by simulating flower pollination deeds. The PBO algorithm is used to solve the optimization problems, integer programming problems and problems related to the wireless sensor network etc[1]

In wireless sensor networks, the pollination based optimization improves the network lifetime by associating the nodes of the cluster according to the distance to the proper cluster head. The main purpose to intra-cluster distance, the PBO algorithm divides the network into clusters and selects the cluster head based on energy as well as distance. It associate the cluster nodes to each cluster based on the intra cluster distance optimization function. It selects the best cluster head that gives the guarantees of least amount of cost between the communication of cluster head and cluster members and communication between base station and cluster head and nodes also consume less energy for transferring the data between the cluster and from cluster head to base station[1].

Pseudo code for selection of cluster head and cluster member nodes using proposed pollination based algorithm Considering BS as the base station, AE is the average energy of the network, CH is the cluster head, and CM is the cluster member, disti and distj are the distance of nodes from the base station. Considering E as the set of energy of all the nodes, N is the total number of nodes.

a) All the nodes send their location and present energy to BS.

b) BS marks only the higher energy nodes and calculates the AE of the network

Cluster head Selection (AE, CM, N, CH, E)

1. I 1
2. While I <= N
3. If (Ei>AE) then

4. CH (i) = True
5. Else
6. CM (i) = True
7. End if
8. For(j = 1; j < N; j++)
9. If (Ei = Ej)
10. i++ then
11. Apply the PBO algorithm
12. If (disti<distj) from BS, then

13. CH (i) = True
14. Else
15. CH (j) = True
16. End if
17. End if
18. End while

Conclusion:

Energy efficient cluster based routing protocol is used to enhance the lifetime of the network. In this paper, The PBO algorithm is used for clustering in Wireless Sensor Network. It is showing for homogenous wireless sensor environment. This protocol enhances the wireless sensor network lifetime by selecting the cluster head based on their remaining energy as well as distance. And it associates the cluster nodes according to the distance to the proper cluster head. Therefore, OLEACH-C protocol selects the best CHs that assure a routing optimization with the lower energy consumption and minimum communication links` cost between nodes within each cluster and other energy efficient communication protocols for WSN.

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